Journal of Informatics and Web Engineering
Vol. 2 No. 2 (September 2023) eISSN: 2821-370X

QR Food Ordering System with Data Analytics

Chee-Chun Wong[1], Lee-Ying Chong [2*], Siew-Chin Chong[3], Check-Yee Law[4]
[1,2,3,4]Faculty of Information Science and Technology, Multimedia University, Jalan Ayer Keroh Lama, 75450 Bukit Beruang, Melaka, Malaysia.
**corresponding author: (lychong@mmu.edu.my, ORCiD: 0000-0002-4957-6460)*

Abstract - As the epidemic starts to slow down and Malaysians are more confident about containing the outbreak with the norm of vaccination, diners have been aching to return to dining rooms, with many restaurants functioning at full capacity, but staffing is an entirely different story. As restaurateurs try to keep their businesses running at full speed and solve limited staff issues, there is only one solution: process automation. This paper aims to design a food ordering system that covers the benefits of automating the ordering process using the QR code and provides visualised insightful information based on the business data. Customers place the food order by scanning the QR code on the restaurant table, and it is then brought to a digital version of the restaurant's menu and make orders. The proposed system automates customer bills after the order, and it helps reduce human error in calculating bills. On the other hand, the proposed system has an admin interface that enables restaurant owners to modify the restaurant's menu, generate QR codes for the new dining table, receive orders from customers, and get automated bills generated by customers' orders. Most importantly, the system allows restaurant owners to have an insightful view of their business data such as visualised charts on sales data, highlighted crucial data and so on to improve decision-making and forecasting future demand using data analysis techniques which are not populated in similar systems currently. Machine learning has become a huge trend nowadays, it is also included to in the proposed system to forecast more valuable data for the business.

Keywords— Restaurant, QR code, Automate, Ordering system, Data analysis

Received: 30 June 2023; Accepted: 04 September 2023; Published: 16 September 2023

I. INTRODUCTION

As the epidemic starts to slow down and Malaysians gain more confidence in containing the outbreak through widespread vaccination, the restaurant industry is witnessing a surge in diners eager to return to dining rooms. However, a significant challenge faced by restaurateurs is the limited availability of staff to keep up with the increased demand. In order to maintain their businesses at full speed and overcome staffing issues, the solution lies in process automation and leveraging the power of data analytics.

One of the key technologies being utilised is Quick Response (QR) codes, which offer a more advanced level of information delivery compared to traditional barcodes. QR codes are extensively integrated into cryptocurrency platforms and systems, particularly for identifying Bitcoin addresses, facilitating seamless online transactions. Nowadays, QR codes are also widely used to transmit URLs to mobile devices using the devices' camera functions. This method proves to be efficient, secure, and accurate, as each QR code possesses a unique image and usage.

Journal of Informatics and Web Engineering
https://doi.org/10.33093/jiwe.2023.2.2.18

Published by MMU Press. URL: https://journals.mmupress.com/jiwe

Integrating QR codes with online site URLs is particularly beneficial for conveying unique information, making it a growing trend due to the ubiquity of mobile devices in our daily lives.

Therefore, the objective of this proposed work is to develop a QR Food Ordering System, a web-based application that encompasses the advantages of automating the ordering process. Customers can simply scan a QR code located on their table, which redirects them to a mobile-friendly, digital version of the restaurant's menu. From there, customers can conveniently place their orders directly from their phones. The system automates the generation of customer bills based on their orders, reducing the possibility of human error during bill calculation. Simultaneously, the system empowers the restaurant staff to modify the menu, receive orders from customers, and generate automated bills, allowing them to handle customer payments seamlessly. Moreover, the integration of data analytics within the QR Food Ordering System offers significant benefits to restaurant owners and managers. By capturing and analysing various data points, the system provides valuable insights that enable informed decision-making and the ability to forecast future demand.

The QR Food Ordering System distinguishes itself from contemporary ordering platforms by harnessing the power of data analytics. While traditional systems focus on facilitating transactions, this innovative solution goes beyond, leveraging customer preferences, order histories, and other data to empower restaurateurs with unprecedented insights. By seamlessly integrating data analytics, the system provides a comprehensive understanding of customer behaviors, leading to a tailored and immersive dining experience.

Unlike its predecessors, this system transforms raw data into actionable wisdom. It enables restaurateurs to refine menus, identify popular dishes, and anticipate trends with remarkable precision. The depth of insight allows for strategic decision-making that heightens operational efficiency and cultivates customer satisfaction. With data guiding every aspect of the dining journey, from menu curation to resource allocation, this system ushers in a new era where technology and culinary expertise harmonize to create exceptional dining ventures.

II. LITERATURE REVIEW

A literature review is a crucial step in developing a QR code food ordering system with data analytics as it provides a comprehensive understanding of existing research and industry practices. By conducting a literature review, during the development phase, it can gain insights into the challenges, opportunities, and best practices related to integrating QR codes, food ordering systems, and data analytics. The review helps identify the current state of the art, technological advancements, and potential gaps in knowledge that need to be addressed. It also enables the examination of different methodologies, algorithms, and frameworks used in similar systems, along with their strengths and limitations. Additionally, the literature review aids in understanding the impact of data analytics on the food and beverage industry. By synthesising the findings from relevant studies, the literature review serves as a foundation for designing and implementing an effective QR code food ordering system that harnesses the power of data analytics.

A. Digital Food Ordering System

Nowadays, everyone just about everywhere uses the internet. Every day, people benefit from being able to carry out tasks like searching for information, chatting with friends and family, and communicating with colleagues. Since practically anything can be done online, the internet is incredibly practical for individuals. The internet and telecommunications have expanded quickly. Some industries have begun to use this technology in their operations. This move has made the company to be operated more effectively and efficiently [1].

Customers can access services and information from a distant server, giving them access to databases over a network or through the internet. Nowadays, people can work on or retrieve information and data via mobile devices, and they are more affordable and compact in current technologies. Most of these devices support this wireless technology, which also means they can get information and data from remote areas. The technology can be shown in Figure 1 to have a clearer concept.

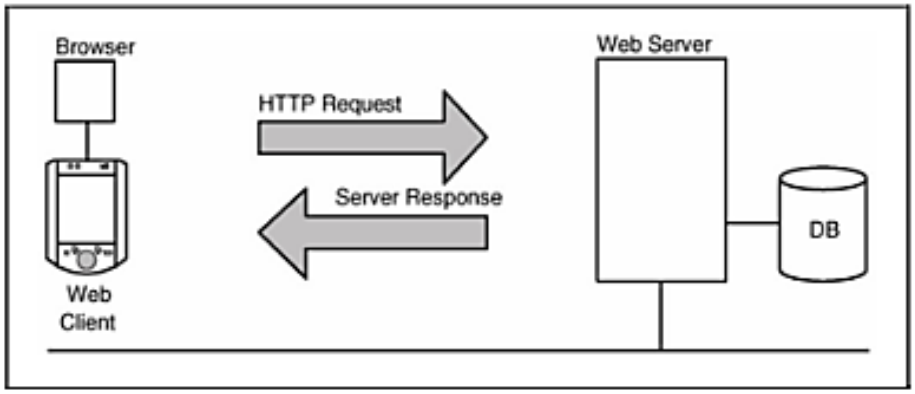

Figure 1. Process Of Transmitting Data From End To End

B. QR Code Mechanism

QR code take a crucial responsibility in the proposed system, mobile tagging is the term that describes the process of decoding, scanning, and extracting from two-dimensional barcodes using a camera phone which is action required by user. A QR code scanner is required to read a QR code. These scanners are incorporated into several camera-enabled mobile phones, and any smartphone may download third-party scanner software. When a QR code is photographed, its application processes begin, and it transforms into text that can be read. The code may contain a company's website URL or contact details. QR codes may be designed for various programs like web browsers, instant messaging, SMS, email, and even streaming video in order to provide a relevant and interactive consumer experience [2].

The reader focuses on situating the QR Code picture. Reader also distinguishes between black and white blocky patterns and the three finder patterns. The formatting information is deciphered in the second phase. At this point, the alignment patterns are made available, and the format information section is subjected to mistake correction. When symbols are successful, they serve as general guidance; when they are unsuccessful, formatting information is attempted to be decoded using their mirror images, with the aid of mistake correction.

Choosing the QR Code variant is the third step. Version information is read at this point, and the QR Code's version is confirmed. The data masking is then removed. Reading the characters, identifying the mistake, and recovering the data are the fifth and sixth steps. These actions rectify the error by using the error correction codeword. When a mistake is found, it will be corrected. The seventh stage involves dividing the data codewords into two groups based on the mode and character count indications. Decoding the data character based on one or more modes will provide the original data [3].

C. Data Analytics with Machine Learning in Food & Beverage Industry

Data analytics in the food and beverage industry is not only doable but also highly beneficial for businesses. With the advancement of technology and the availability of digital platforms, restaurants and food companies can collect and analyse vast amounts of data to gain valuable insights. The food and beverage industry has witnessed a significant transformation through data analytics, enabling companies to make informed decisions, optimise operations, and enhance customer experiences. By analysing data on customer preferences, order history, market trends, and production processes, businesses can identify areas for improvement, streamline operations, and tailor their offerings to meet customer demands.

Data analytics in the food and beverage industry enables restaurants to optimise inventory, reduce waste, and predict future demand. It helps identify growth opportunities, reduce expenses, and improve quality control. By analysing customer preferences and trends, restaurants can meet changing demands, enhance the customer experience, and personalise recommendations. Data analytics also aids in reducing waste, saving resources, and reducing environmental impact. Overall, data analytics empowers restaurants to make informed decisions, optimise operations, and stay competitive in the market [4].

In contemporary studies of data analytics, predictive analytics and descriptive analytics are widely used due to their simplicity and effectiveness [5]. Predictive analytics involves using historical data and statistical algorithms to make predictions about future outcomes or trends. By leveraging techniques such as regression analysis, time series analysis, and data mining, predictive analytics enables businesses to forecast customer behavior, demand patterns, and market trends. On the other hand, descriptive analytics focuses on analysing past data to gain insights and understand what has happened in a particular context. It involves summarising and visualising data through charts, graphs, and dashboards to identify patterns, trends, and anomalies. Data visualisation plays a crucial role in presenting complex information in a visual format that is easily interpretable by stakeholders.

Furthermore, machine learning approaches are employed to perform both predictive and descriptive analytics, enabling systems to learn from data, identify patterns, and make data-driven decisions. Linear regression is a most used valuable machine learning approach used in predictive analytics to analyse the relationship between a dependent variable and one or more independent variables [6]. In the context of a QR code food ordering system with data analytics, linear regression can be applied to predict customer behavior and demand patterns. By examining historical data, such as customers' order history, and timed daily or monthly, linear regression can identify patterns and correlations that help estimate future customer preferences and order volumes. This information can be used to optimise inventory management, staffing, and resource allocation. Additionally, linear regression can provide insights into the impact of different factors on customer behavior, allowing businesses to make data-driven decisions regarding pricing strategies, menu offerings, and marketing campaigns. The combination of data visualisation and machine learning allows businesses to derive actionable insights from large datasets and make informed decisions for strategic planning, resource allocation, and performance optimisation.

D. Existing Food Ordering Systems

YhoFoodie, known as Yhosana Foodie Sdn. Bhd, is an intelligent F&B service platform that provides a comprehensive and efficient improvement plan for merchants, which can help enhance the customer experience and streamline business operations [7]. A set of standardised wisdom cloud restaurant products from restaurant buffet service to overall operation data Management. Self-service order is to meet the customer choice meal, the next single, checkout payment, call service and other requirements. The need to integrate their own POS system is needed to allow the system fully utilised by the restaurants. For example, an advanced version of the POS system that is provided by them is needed to allow users to use data management functions. Moreover, data visualisation on sales volume, transaction amount and revenue are shown to assist owners understand more about the business.

Secondly, the first integration of the iPad digital ordering platform in Malaysia has been introduced by *SAKAE Sushi Malaysia,* a Japanese sushi brand owned by Sakae Holdings Limited with over 50 locations globally [8]. It aims to enhance the eating experience for patrons and handle complicated orders quickly, precisely, and effectively. The revolutionary interactive menu screen was installed on each table for the first time in a Japanese restaurant, allowing diners to examine the image and description of each item before making their orders in the kitchen. The restaurant's efficiency has been enhanced because of this two-way communication menu system, which has resulted in a 40% reduction in serving time. As a result, customers have less trouble waiting for store employees and may readily monitor their bills. With the integration of the iPad ordering platform, all the data is kept in order to do analytics based on customer orders, especially determining the hot selling and slow selling dishes. It has also the ability to keep track of purchase behavior, trends for food, time used for serving a dish and also transaction amount made for different types of menu categories.

My QR Menu is a platform that is developed by MA Venture Marketing [9]. Their marketing strategy is to provide an online platform that is similar to other food ordering systems but with lower pricing. However, they promised the system would work perfectly fine to replace the old physical menu by implementing QR Code Menu. It aids in preventing time wasting that occurs frequently in restaurants, such as waiting for the order, delivery, or invoicing. My QR Menu promised an easy, straightforward, efficient, and courteous system. There is no need to download any applications. Simply peruse the menu after scanning the QR code on the dining tables, allow customers to make their own selections, and wait for delivery of their meal instantly. Restaurants have the option to activate various services that allow consumers to place orders for food and drinks. However, poor backend accessibility by My QR Menu is one of the reasons that make some of the users unsatisfied as they feel the services are limited. The comparison is shown in Table 1 to have a glance of view about what is the difference between proposed system and existing systems.

Table 1. Comparison Of The Existing System And Proposed System

Feature	Yhofoodie	Sakae Sushi	My QR Menu	Proposed System
Menu Management	Yes	Yes	No	Yes
QR Code for Food Ordering	Yes	No	Yes	Yes
Table Number is Embedded in QR Code	Yes	No	No	Yes
Automated Order Process	Partial	Fully	Partial	Fully
Automated Billing Generation	Yes	Yes	Yes	Yes
Data Visualisation on Past Data	Yes	No	No	Yes
Data Analytics on Past Data	No	Yes	No	Yes
Require of Expensive POS System	Yes	Yes	Depends	Depends

The proposed system stands out in comparison to the other solutions outlined in the Table 1. While each system covers aspects such as menu management, QR code-based ordering, and automated billing to varying extents, the proposed system uniquely distinguishes itself by incorporating table numbers within QR codes and offering a fully automated order process. However, the most prominent divergence lies in its robust utilization of data analytics. Unlike the other options, the proposed system not only provides data visualization of past information but also harnesses sophisticated data analytics to extract insights from historical data. This equips businesses with the ability to make informed decisions, enhance operational efficiency, and foster growth through a comprehensive understanding of customer preferences and behaviors. Furthermore, the proposed system's advantage lies in its potential to function without the need for an expensive POS system, rendering it a cost-effective and data-centric solution for modern restaurant management.

III. THE PROPOSED SOLUTION

This section defines the architecture, diagram, and data for the proposed system. It is the section where the ideas, strategies, or interventions are outlined to provide a resolution or answer to the problem at hand.

A. System Design

A use case diagram illustrates the relationship between actors and the proposed system. As showed in Figure 2, the actors in the use case diagram involve the customer, staff (waiter and kitchen staff) and admin. Customers browse the menu after scanning the QR code on their dining table and make the food ordering. Meanwhile, staff (waiter and kitchen staff) check any relevant information about customers' orders. Admins of the restaurant create new QR codes for new tables and check QR codes for existing tables in case they need to print out a new QR code sheet to put on tables. They can also modify the menu and access the data analysis features in the proposed system.

An activity diagram showcasing the involvement of customers in the food ordering process which shown in Figure 3. First customer needs to scan the QR code that is available on the dining table, then they can view the menu provided by the restaurant, orders are submitted by customers and the order data are stored in a database.

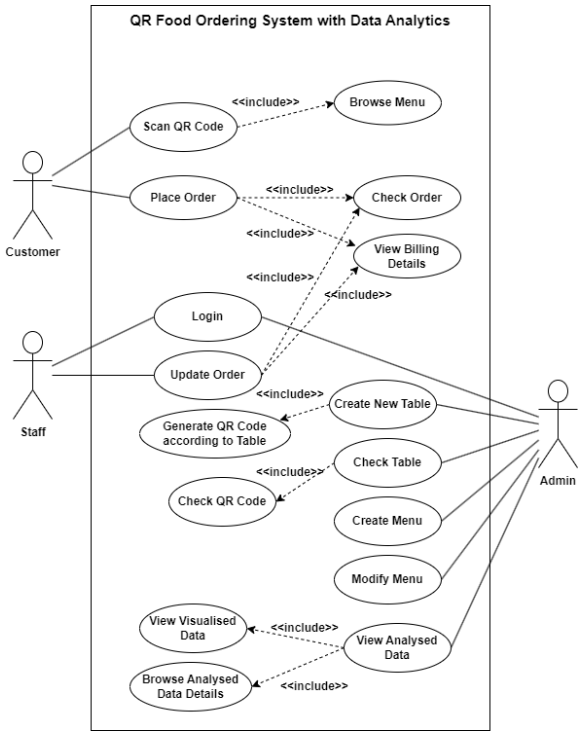

Figure 2. Use Case Diagram Of The Proposed System

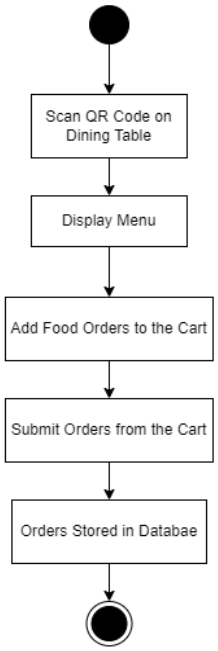

Figure 3. Activity Diagram For Customer

As illustrated in Figure 4, Customers must log in when accessing the system, and the system verifies their login credentials automatically. Upon logging in, waiters can review order details of customer and update the order status once the customer has completed their meal and made the payment. Kitchen staff can view customer orders and update the status of dishes once they are prepared and taken out of the kitchen. Lastly, admin users can create new tables, view existing tables, modify menus, and access sales analysis upon logging into their accounts.

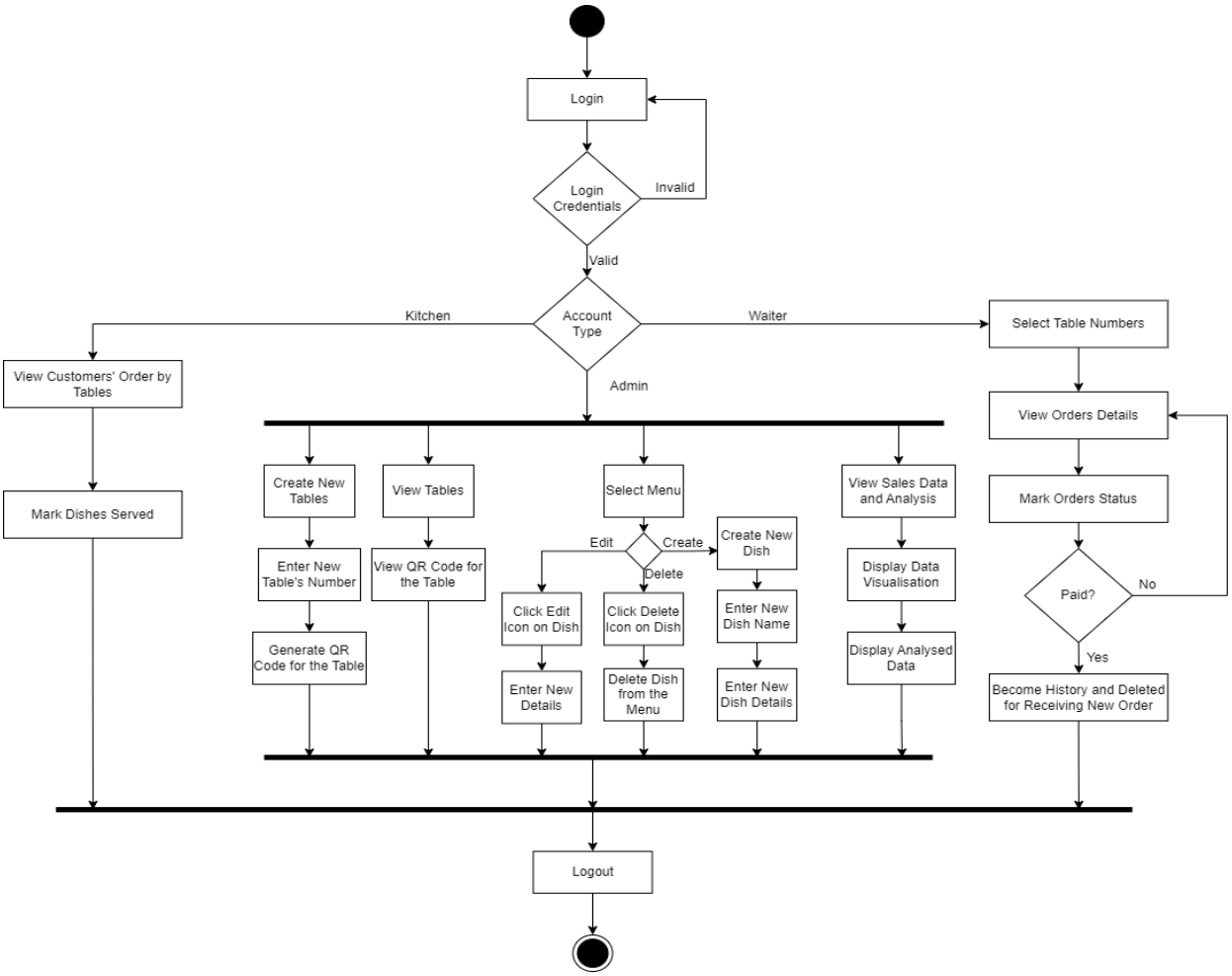

Figure 4. Activity Diagram For Staff (Waiter And Kitchen) And Admin

A context diagram of how the customer, staff and admin interact with the system is displayed in Figure 5. Customers can directly scan a QR code to use the system which shows by the activities in the diagram. Still, it is notable that the admin and staff must provide login information to get a different response from the system, which made both of them are separated and has their own activities. The data flow diagram in Figure 6 shows how the data flows between three external entities (customer, staff, and admin) through ten processes and four data sources (Staff, Menu, Order, Table) in the proposed system.

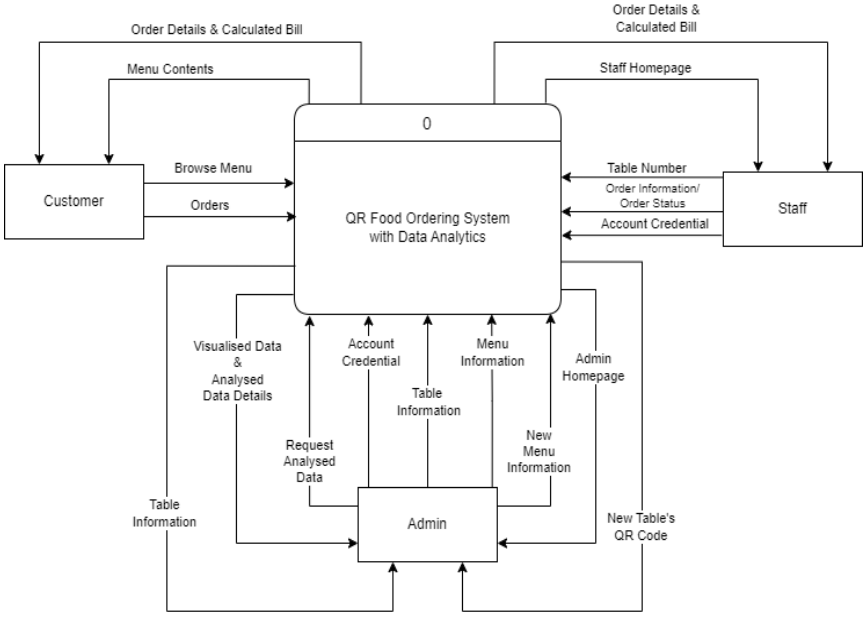

Figure 5. Context Diagram Of The Proposed System

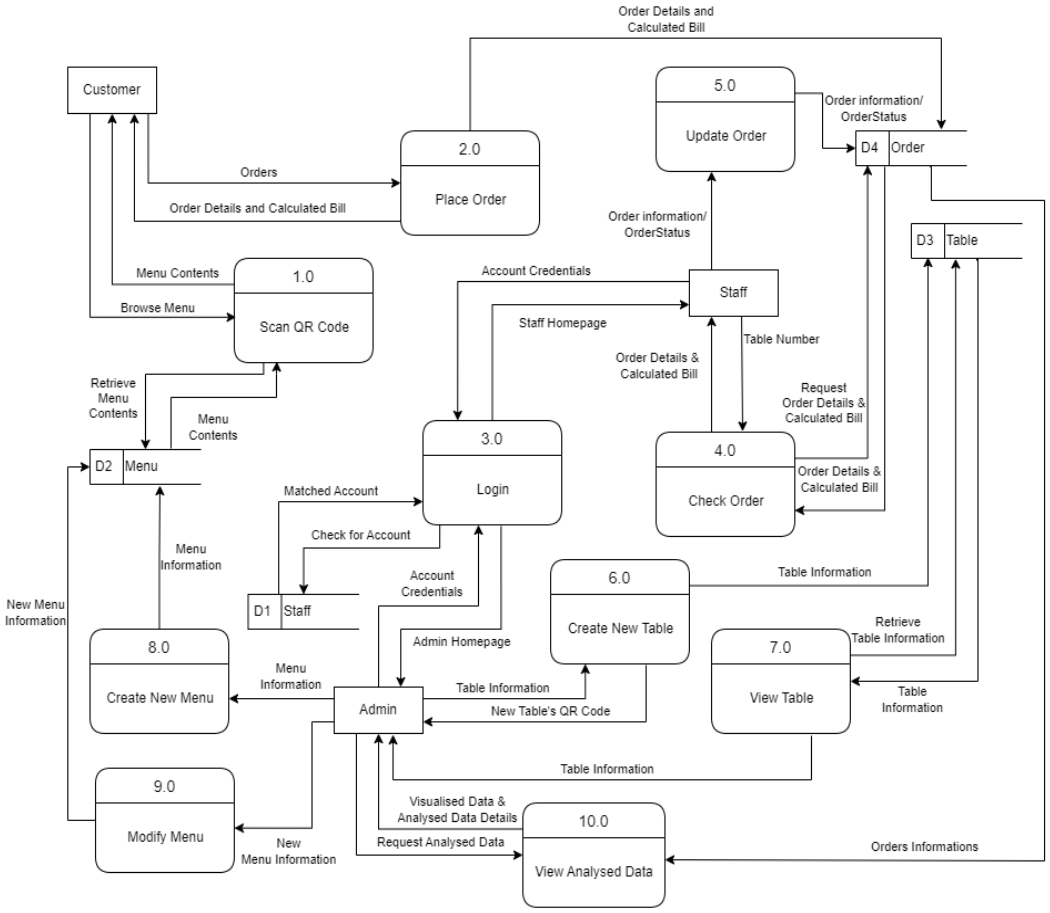

Figure 6. Data Flow Diagram Of The Proposed System

B. System Architecture

System architecture contains the front-end and back-end of the proposed system, illustrated in Figure 7. The front-end component handle interaction between users and the proposed system through a web-based user interface, and the back-end components handles all the data operations requested from the front-end components. As shown in Figure 7, front-end components involve the web development tool such as HTML, SCSS, Bootstrap, and JavaScript to create the graphical contents (User Interface), QR code generation and Data Visualisation in the proposed system. Meanwhile, back-end components involve server-side scripting PHP that handle the user's request and MySQL that store the content in the database.

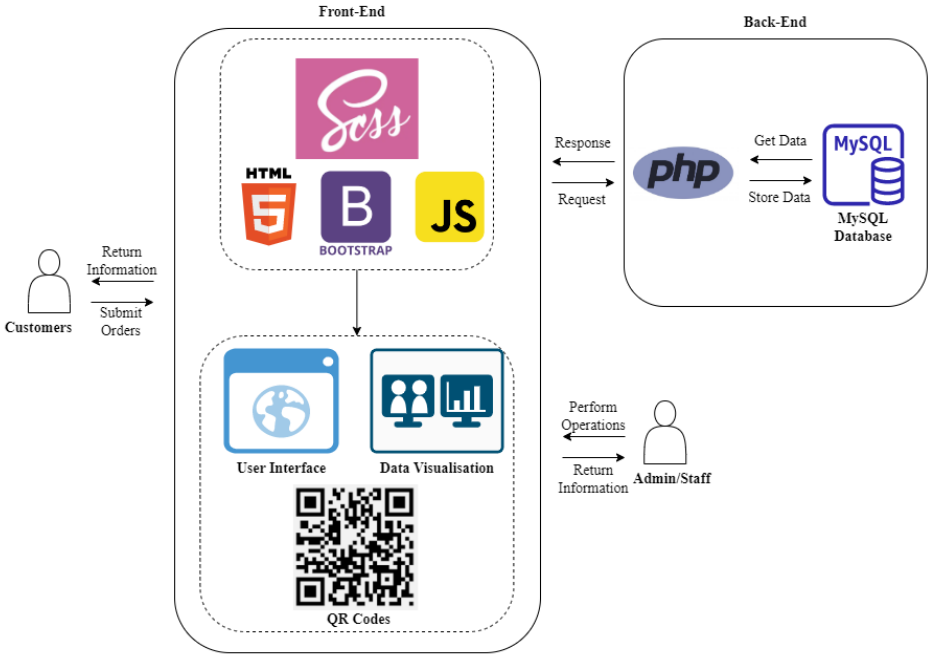

Figure 7. System Architecture Of The Proposed System

C. Generation of QR Code

The proposed system auto-generates a QR code with an embedded URL of the table number to ensure the table number is stated and recorded in the order submitted by the customer later. As shown in Figure 8, jQuery script is needed for simplifying the JavaScript scripts that is required by the API. Google Chart's API is invoked to generate QR Code that contains the table number and URL to the restaurant's menu site [10]. Table number is included to enable the system to recognise the orders submitted by customers from which table. By specifying the chart type (QR code), size for chart, and URL to encode, the Google API create the QR code that is encoded with the URL in the size that is specified by the proposed system.

D. Generation of Visualised Charts

The proposed system allows data visualisation based on the past order data. Data visualisation helps the admin to improve decision making and forecast future needs. The process of data visualisation is shown in Figure 9. The proposed system imports the library of Fusion Chart and uses the required scripting language, JavaScript, to create various charts [11]. Since past data is required to create the charts, a database connection is required to obtain the past data stored in the database. The involved table is "Order Table", which stores all orders placed by customers. However, since PHP is a server-side scripting, it cannot be integrated with JavaScript, which is a client-side scripting. Therefore, JSON is needed to pass the value received from PHP to JavaScript so that data visualisation can be done with past data [12]. Finally, the charts can be displayed on the system pages based on the past data from the database passed by the scripts that run Fusion Chart.

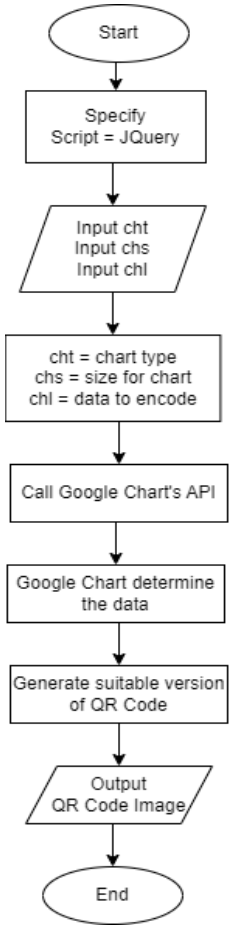

Figure 8. Flowchart Of Generating QR Code

E. Linear Regression

Linear regression is a fundamental statistical technique used in data analytics to model the relationship between a dependent variable (usually denoted as '*Y*') and one or more independent variables (usually denoted as '*X*') [13]. In the context of restaurant sales analysis, linear regression can be employed to uncover patterns and associations between various factors that might influence sales figures. The equation for a simple linear regression model is as in Equation (1):

$$Y = \beta 0 + \beta 1\ X + \epsilon \tag{1}$$

Where:

- Y represents the dependent variable (e.g., sales)
- X represents the independent variable (e.g., time, menu items, marketing expenditure)
- $\beta 0$ is the intercept term, representing the value of Y when X is 0
- $\beta 1$ is the coefficient for X, representing the change in Y for a unit change in X
- ϵ is the error term, accounting for unexplained variability in Y

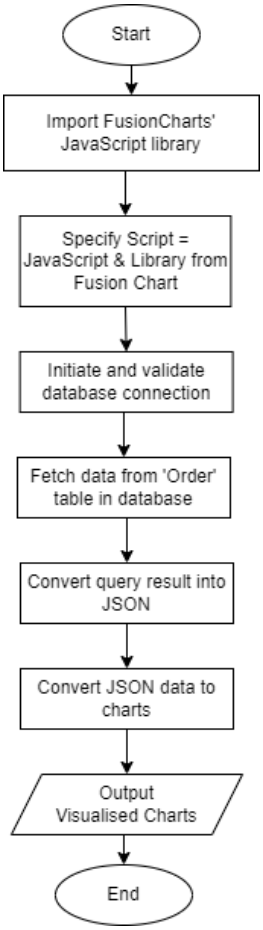

Figure 9. Flowchart Of Generating Visualised Charts

In the field of restaurant sales, the use of linear regression as a data analytics technique reveals the complicated interplay between multiple variables and their effects on sales dynamics. By systematically examining elements such as menu prices, special offers, and external events, a comprehensive understanding of their respective contributions to sales performance emerges. Fitting a linear regression model to historical sales data creates a quantitative framework that offers insights into the nuanced relationships between these variables and overarching sales outcomes.

The linear regression model applied to historical sales data quantifies the extent to which variations in factors such as menu prices, promotional strategies, and external events correlate with corresponding variations in sales performance. The coefficients assigned to each independent variable provide information about the direction and magnitude of their influence on the dependent variable, in this case, restaurant sales. This numerical interpretation goes beyond mere observation and makes it an invaluable tool for strategic decision making in the restaurant landscape.

By using the insights gained from linear regression, restaurateurs gain a strategic advantage in optimizing their business operations. The results of the model have the potential to reveal patterns that would otherwise be hidden by the complexity of real-world interactions. With this knowledge, restaurateurs can align menu pricing structure with market demand, develop promotional initiatives that leverage historical trends, and allocate resources wisely to maximize sales and revenue. In essence, the application of linear regression in the context of restaurant sales transforms raw data into actionable intelligence that helps operations create sound, data-driven strategies that drive growth and sustainable success.

F. Sales Forecast using Linear Regression by PHP-ML

Since the proposed system uses linear regression to generate prediction values based on sales data, importing the library, PHP-ML is useful in integrating PHP-fetched data from the database into a dataset required for machine learning [14]. The present dataset is valuable training data for developing a linear regression model using PHP-ML. The dataset consists of approximately 450 records composed of multiple parties that simulate the possible orders of customers in reality and includes several columns, each representing different attributes in a restaurant context. These attributes include "order_number", "order_id", "food_id", "order_status", "table_id", "date" and "time". Using the linear regression functions of PHP-ML, this dataset can be used to build a predictive model that reveals patterns and relationships between these attributes and a given target variable, such as "sales_amount".

The diverse information in this dataset is important in informing the model about the intricacies of food orders and their potential impact on sales. The "order_number", "food_id" and "table_id" columns can be considered as the independent variables (features), while the "sales_amount" column serves as the dependent variable (target). By inputting these features into the linear regression model, the training process aims to establish a mathematical equation that accurately approximates the relationship between the variables. Consequently, the trained model can later be employed to predict future sales volumes based on input data related to the same attributes.

Incorporating PHP-ML's linear regression capabilities with this dataset empowers the creation of an analytical tool that aids in optimizing pricing strategies, identifying influential factors, and improving operational decisions for restaurant sales. As the model learns from the historical trends contained in the dataset, it equips restaurateurs with predictive insights, enabling them to make informed choices to enhance revenue generation and overall business success. Following is the technical approach to implement linear regression into the proposed system. A pseudocode is presented, showing the simplified implementation of PHP-ML's linear regression. The process is then illustrated in a flowchart in Figure 10.

```
START
        SET database_connection = ConnectToDatabase("restaurant_db")
                features = [], target = []
                query = "SELECT order_number, food_id, table_id, sales_amount FROM orders"
                result_set = ExecuteQuery(database_connection, query)
        FOR each row IN result_set
                features.append([row['order_number'], row['food_id'], row['table_id']])
                target.append(row['sales_amount'])

        END FOR
                dataset = CreateArrayDataset(features, target)
                regression = CreateLinearRegressionModel()

        TrainModel(regression, dataset.getSamples(), dataset.getTargets())

        SaveModel(regression, "linear_regression_model.model")

        DisconnectFromDatabase(database_connection)
END
```

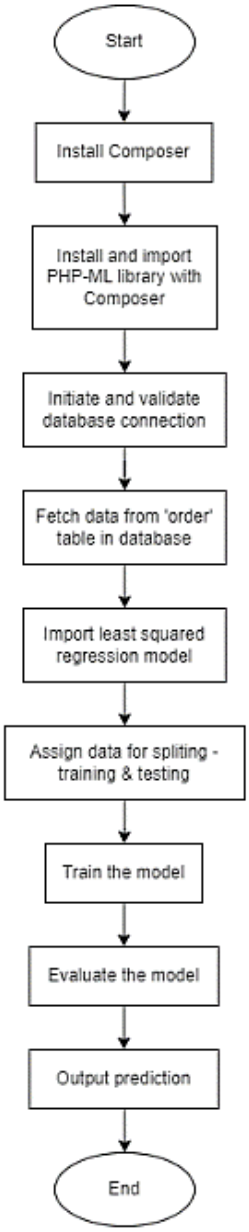

Figure 10. Flowchart Of Using PHP-ML Library To Predict Value

To evaluate the performance of the proposed linear regression model, three different data set sizes were tested: 250, 350, and 450 data. The mean square error (MSE) and R-squared values of the model were calculated for each dataset size to evaluate the accuracy and explanatory power of the model. PHP-ML provides functions to facilitate the calculation of these results. The results indicate that the performance of the model improves as the size of the data set increases, as evidenced by decreasing MSE values and increasing R-squared values. This suggests that the model is getting better at capturing the underlying trends and providing accurate predictions as more data becomes available for training and testing.

Table 2 shows the calculated MSE and R-squared values for each dataset size. The MSE values quantify the average squared differences between predicted and actual sales amounts, while the R-squared values indicate the proportion of the variance in sales amounts that the model explains. Notably, the larger dataset of 450 data points consistently

yields better results, with lower MSE and higher R-squared values. These results underscore the importance of using large data to improve the model's predictive capabilities and strengthen its reliability in real-world applications.

Table 2. MSE And R-Squared Score On Linear Regression With Different Dataset Size

Dataset Size	MSE	R-Squared
250	12.5	0.51
350	8.2	0.75
450	5.3	0.87

In conclusion, the application of PHP-ML's linear regression to the proposed system showcases its legitimacy and effectiveness. The model's ability to analyze and predict sales based on various factors, coupled with its capacity to adapt to different dataset sizes, reinforces its viability for the proposed solution. The demonstrated improvements in model performance with larger datasets further solidify its potential to provide valuable insights and enhance decision-making. As a result, PHP-ML's linear regression emerges as a dependable tool to drive data-driven strategies, optimize resources, and foster continued growth within restaurant operations.

IV. IMPLEMENTATION RESULTS

This section refers to the outcomes obtained during the implementation phase. It presents and discusses the specific results emerged from the practical implementation of the proposed solution.

A. Customer's Interface

The first interface is presented when customers scan the QR code on their phone which illustrated by Figure 11. The interface is the restaurant's menu that is available at the moment. User is able to view the dishes' name, image and their price, if they wish to order them, they just need to press on the "+ Cart" button on the right side of the dish. Then the bottom-right of the proposed system shows a cart button that indicates the number of dishes added to the cart and the user is able to see the details in a new page by clicking on it. There is also a category filter on the top which allows users to choose the desired category of their food they want to order; it will only show the food that is under the category.

The cart page shows after the customer clicks on the cart button, which is mentioned above, it is illustrated in Figure 12. It contains a list of items that have been added to cart and along their price. The proposed system automatically sums up the price to show customers their payment amount after having the meal. There is also a remove button to remove the item in the list in case customers change their mind. Lastly, "Submit Order" button allows the customer to send the list of orders to the system. The system will indicate a successful message if the orders are successfully recorded down in the system.

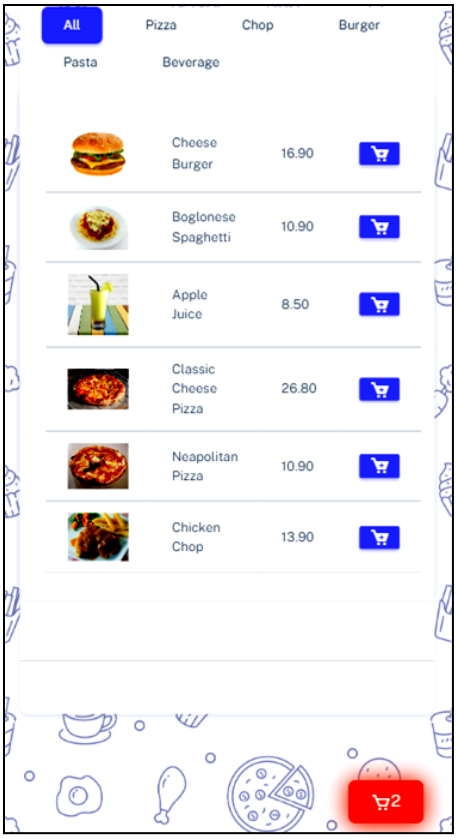

Figure 11. Menu Page For Customer

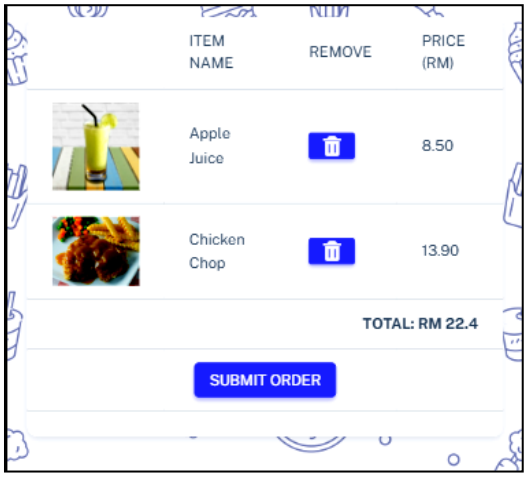

Figure 12. Cart Page

B. Admin Dashboard

The login page of the staff side of the system is illustrated in Figure 13, where every authorised staff has to enter their own ID and password in order to further interact with the system. Once they enter their ID and password, by clicking login, the system validates and directs them into a web page that matches their role.

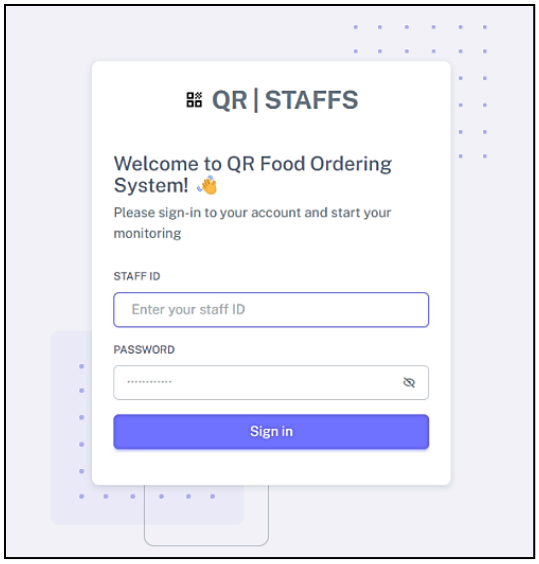

Figure 13. Login Page For Staffs

The admin's dashboard after the system validates the logged in user is admin, is shown in Figure 14. The dashboard mainly presents the current analytics of the restaurant based on the order data by customers. By showing their revenue, sales amount, best-selling items based on different scenarios, it allows admin to have overview business situation, by viewing various charts, then can interpret the pattern and analyse to come out a strategy that benefits the restaurant. By the left side of the page, it is a side-navigation bar that can navigate users to pages that they want, it is consistently available on all pages of the system, but it appears different navigate options based on type of users.

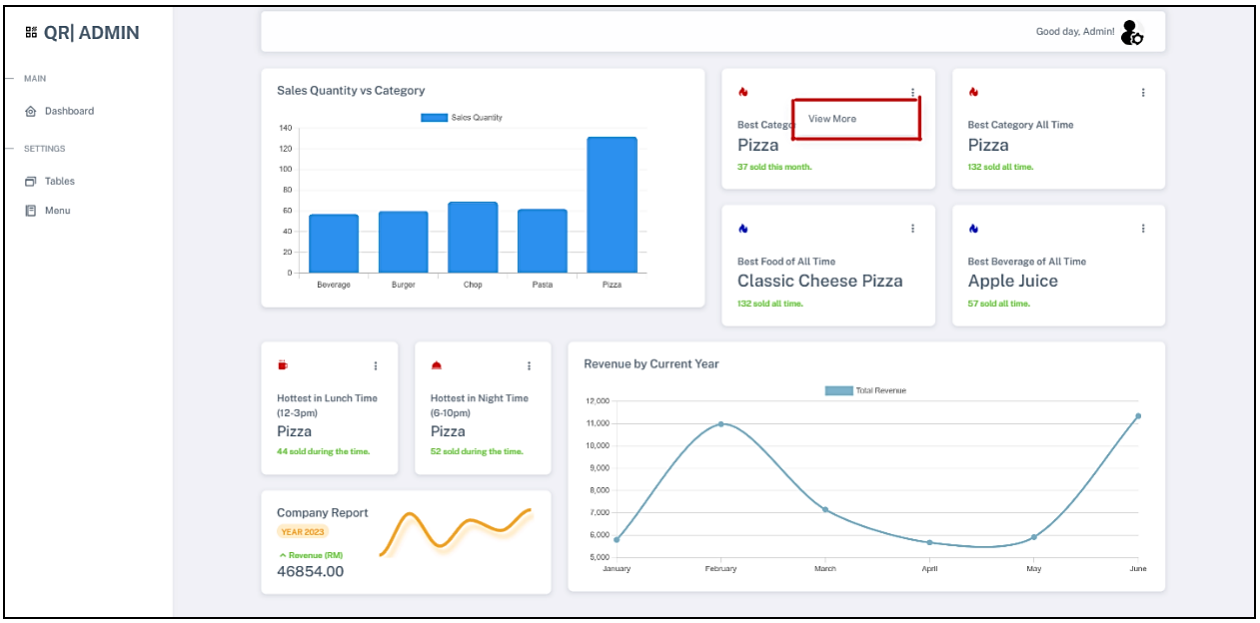

Figure 14. Admin's Analytics Dashboard

After the admin selects the "View More" from the "Best Category" card, it redirects to a page where it shows the best category and worst category, consisting of data at all-time and current month, illustrated in Figure 15. It can show the food inside the category, allowing admin to know which item in the category needs to be aware of, for example, Pepperoni Pizza from the Pizza category is selling slow even though the category is the bestselling category in the restaurant. This allows the admin to find out the problems and deploy strategies to solve them.

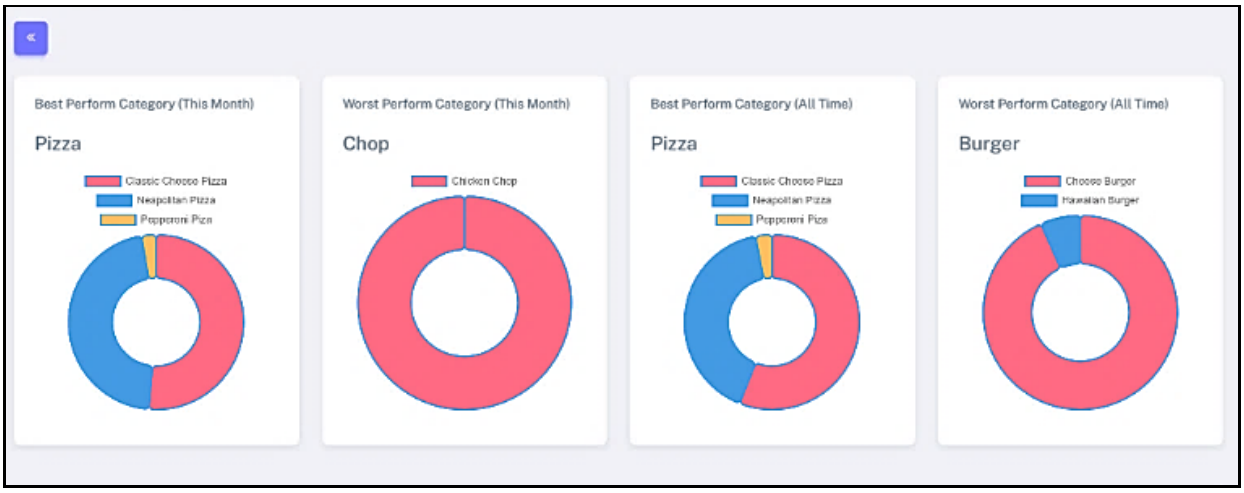

Figure 15. Analytics On Categories Of Menu

However, if admin selects the "View More" from the "Best Food" card, it redirects admin to the page where food data are shown in a chart with forecasting the future data, as shown in Figure 16. These analytics allow admin to have a clearer look on sales of the food based on different months, making it easier to do analysis such as purchase patterns, demand forecasting or hidden information. Forecasting with machine learning methods automatically by the system is also included as a reference to predict future demand.

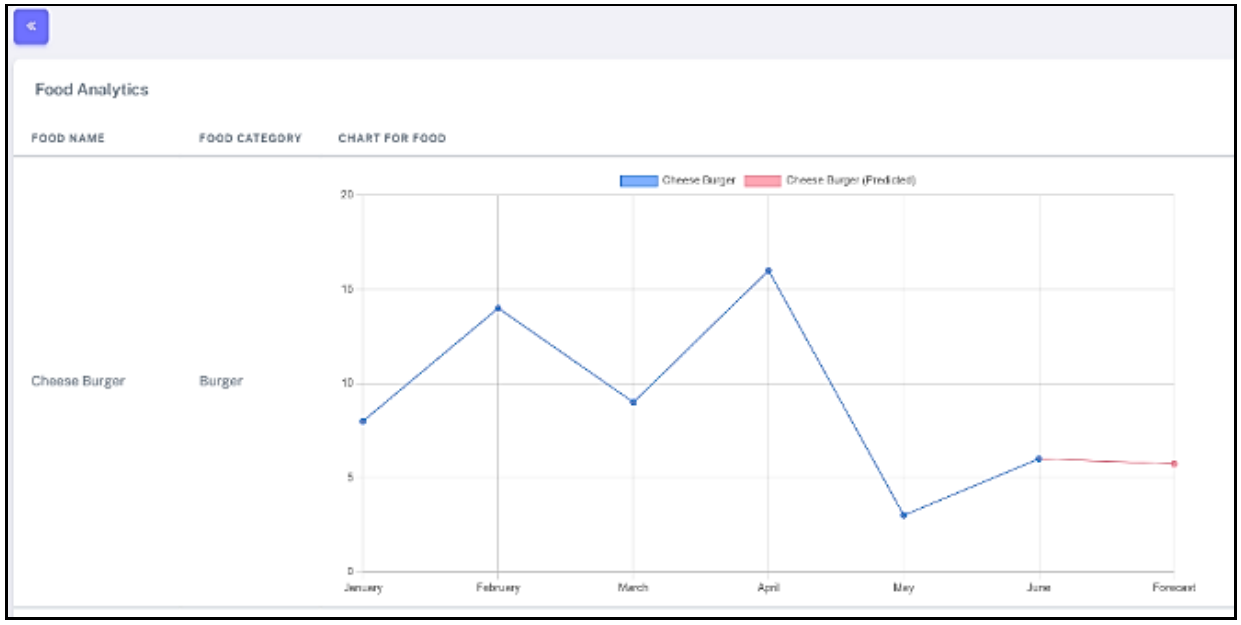

Figure 16. Analytics On Food Of Menu

Moreover, if admin selects the "View More" from the "Category with Time Analytic" card, it redirects them to the page where the sales of the food categories within a day are shown in a line chart, which is illustrated in Figure 17. This helps admin to identify the purchase pattern of each category on a specific timeframe, for example, beverages are selling more during noon period (12pm-2pm), which can be comprehended as customers like to order beverages during the hottest hours during the day. Those can help users to interpret information and propose strategies to promote their sales.

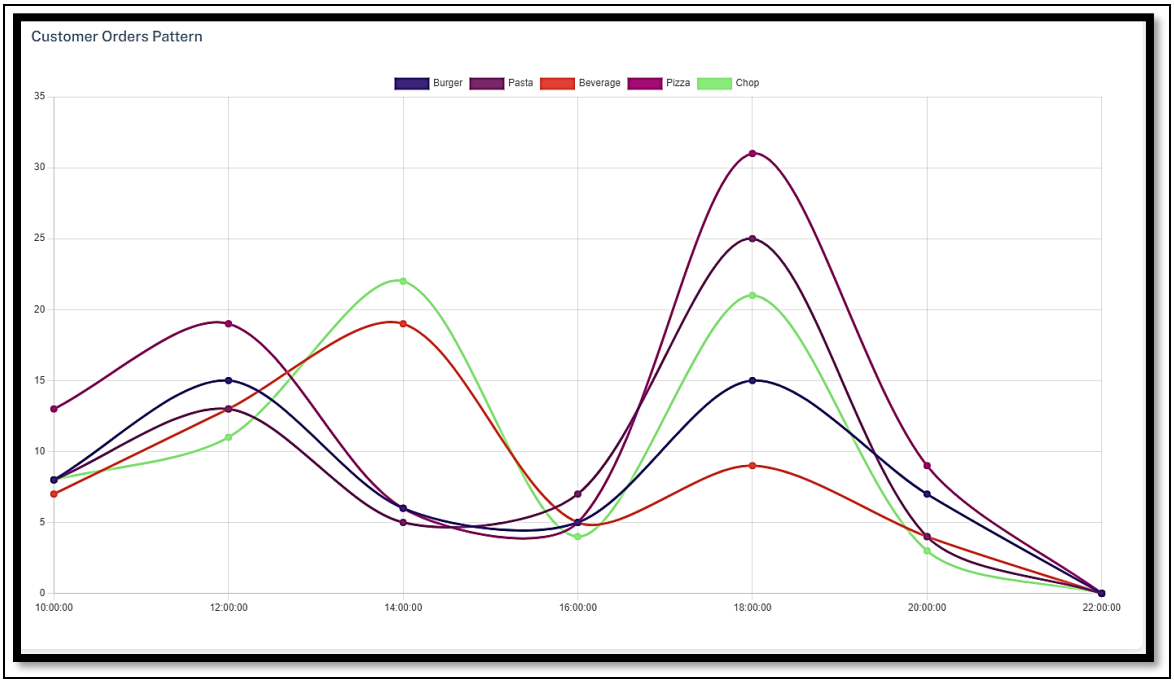

Figure 17. Analytics Based On Different Timeframe

After that, managing tables of the restaurants with a page that has included all the table's information is illustrated in Figure 18, it mainly shows the QR code for customers to scan in order to access the online menu with embed table number, and also its table size and maximum pax for tables. Admin is able to print the code out with the print code function in the action's column. Meanwhile, edit and delete also allow admin to modify the table's information in the action column. There is also a button "Create Table" to create new table information that can show up in the page after creation is successful.

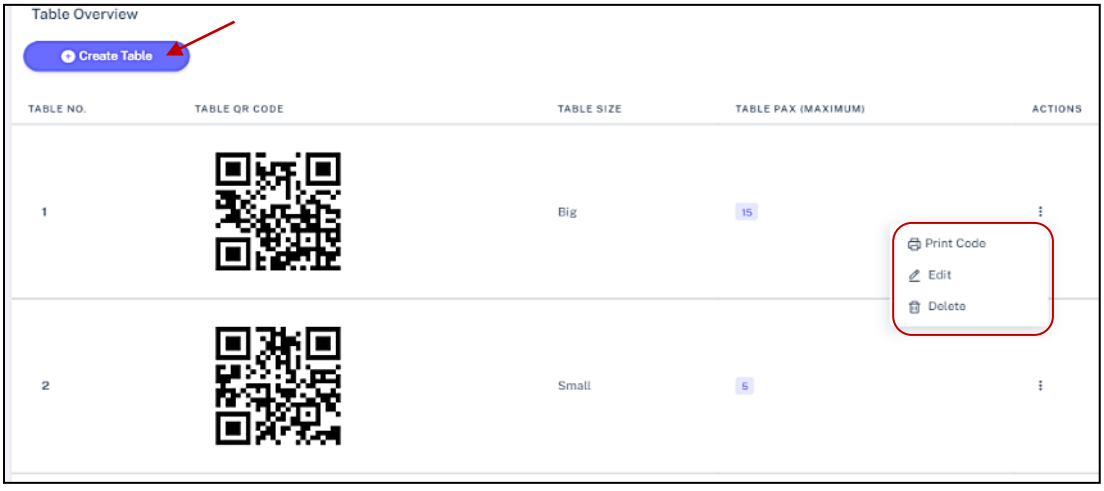

Figure 18. Restaurant's Tables Information Page

The QR code print out page shows by Figure 19 is presented after the admin has selected the "Print Code" function. It appears to print settings from the browser to allow the admin to customise the presentation of the QR code, for instance colour and orientation setting. The QR code is printed out to allow admin to place those QR code on the dining tables, which make customers able to scan it and browse menu for ordering process.

Figure 19. Table's QR Code Printing Function

Furthermore, admin is able to view menu's information after selecting the "Menu" option from the left navigation column. It redirects admin into a page that contains all of the information about the menu which is illustrated by Figure 20, it also allows admin to perform modifying of information from the edit and delete function under the action column. "Create Menu" button allows the admin to create a new item for the menu.

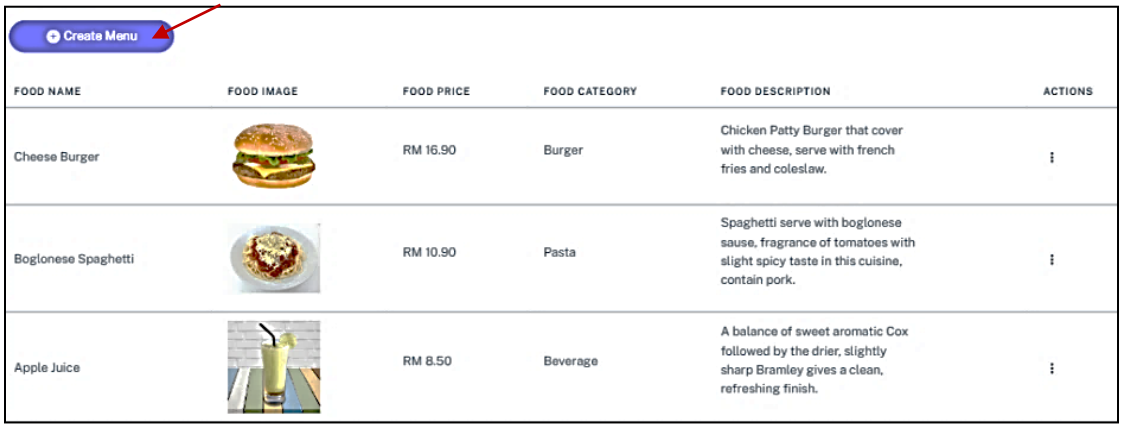

Figure 20. Restaurant's Menu Page For Admin

C. Staff's Interface

Staff such as waiters and kitchen staff have different pages to view when they log in their account, the system automatically validates the ID and decides their direction based on the staff level. This design helps reduce the workload and enhance the staff's job satisfaction [15]. Waiters are directed to a page illustrated by Figure 21 where it can ease the waiter to manage the tables in the restaurant. Tables that currently have orders will show "Currently Active" to indicate the table is occupied with date and time that customers start to order, whereas the empty will show its table size and "Empty". This allows waiters to have a clearer glance of view when they need to direct new customers to empty tables. The "Details" button allows waiters to look into their order details in a dedicated page.

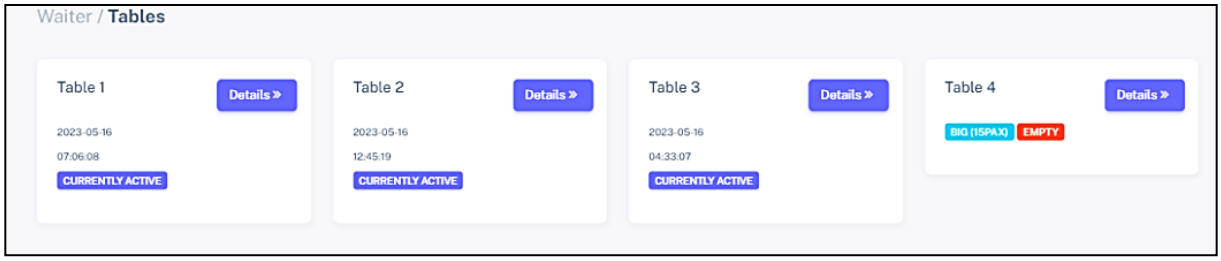

Figure 21. Table Management Page For Waiter

Once the waiter has clicked on the "Details" button of the table management page, the waiter is able to see the order details from the table which shown in Figure 22, such as what customers have ordered and their price to ease their burden when receiving payments. If there is a reasonable reason that customers want to cancel their specific orders, the waiter is able to perform "Delete" to delete the specific item that they wished to cancel. "Paid?" to indicate if the current order by the customer is paid, if yes then it will refresh the table status to empty. However, any actions performed in this page need to be saved by clicking the "Save" button in order to update the latest data of the system.

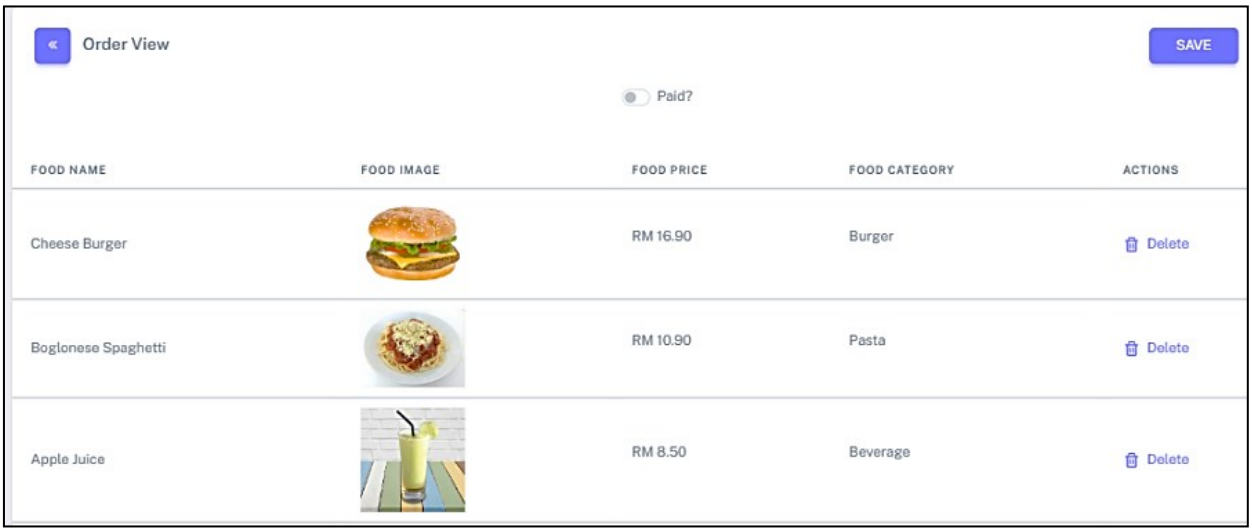

Figure 22. Order Details

If the logged in user is kitchen staff, they then direct to the kitchen staff page shown by Figure 23, where there is an interface that shows all the orders by customers based on tables. The tables are arranged based on the time customers ordered, the earliest order appears at the top left, then the subsequent orders are arranged to the right accordingly, more than that, it then starts at a new row after the previous row. Kitchen staff that are responsible to serve the dishes to the front desk for waiters can tick the checkbox once it is served. If the order of the table is fulfilled, then they can close it by clicking on the "X" button.

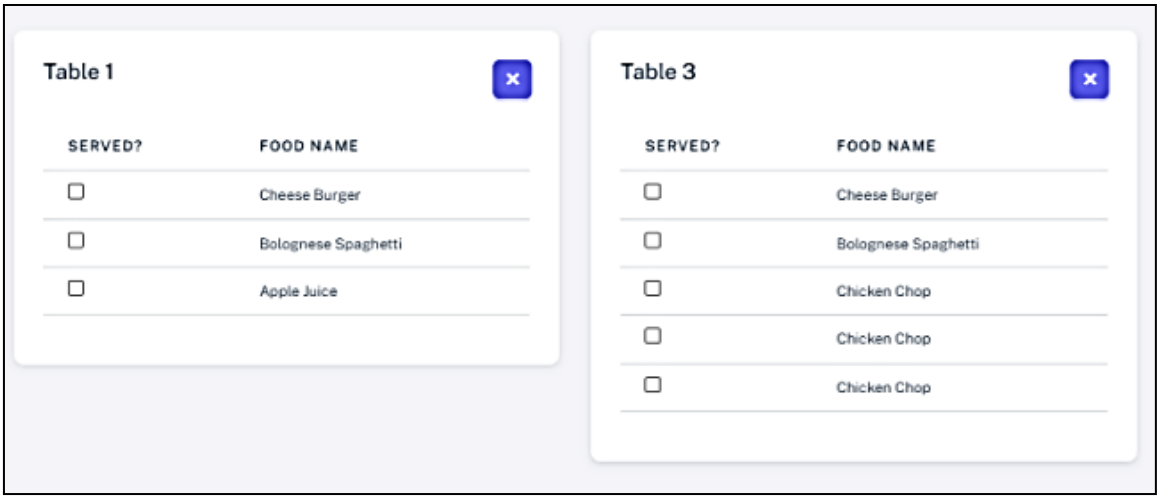

Figure 23. Orders Tracking For Kitchen Staffs

V. USABILITY TESTING

To test the usability of the proposed system, it was managed to conduct usability testing interviews with 8 restaurant owners, who are experienced in implementing similar food ordering system in their restaurant located in Johor Bahru, Johor, Malaysia. The test is aimed to implement the proposed system to their restaurant temporary which up to 3 days and provide valuable feedbacks into the effectiveness of the proposed system.

As shown in Figure 24, there are 7 of the restaurant owners agreed that the proposed system is complete and able to replace the existing system which has similar basic functions such as automating ordering process and ability for back-end operation. One of the restaurant owners disagreed due to the following reason:

- Integration of POS system is lacking, difficult for the owner that mainly receive cash for customer payments.

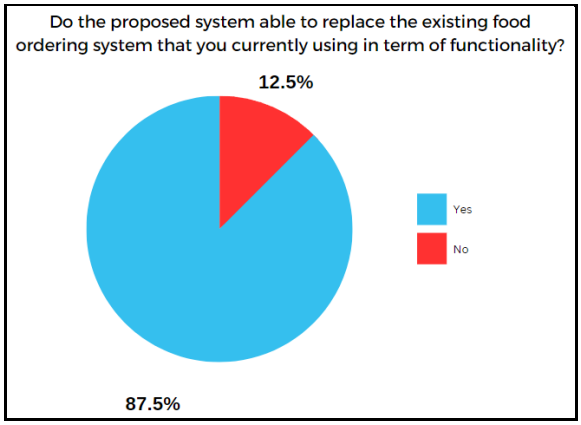

Figure 24. Percentage Of Owners Who Agreed The Proposed System Can Replace Their Existing System

As shown in Figure 25, all of the restaurant owners agreed that the proposed system's analytic dashboard is helping them to view simplified and easy-to-understand charts and data, providing them with information to understand the situation of the daily business.

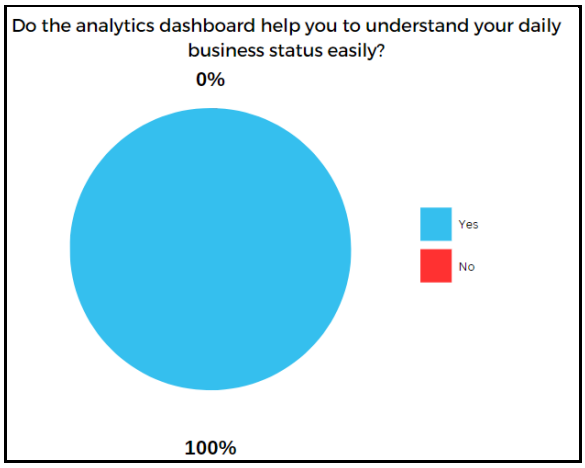

Figure 25. Percentage Of Owners Who Agreed The Analytic Dashboard Is Easy To Understand

As shown in Figure 26, there are 6 of the restaurant owners agreed that the analytics help them in forecasting customer demands, especially understanding the demand during hot-selling hours such as lunch time and dinner time. Some also mentioned that the machine learning approach on helping forecasting the customer demand is interesting and helpful to help them prepare at least the amount of stock that predicted by the system for deal with customer demand in future. However, two of the restaurant owners disagreed due to:

- Lack of experience in handling data for forecasting.
- Data is not helpful when meeting special day for example public holidays or gathering dinner without reservation.

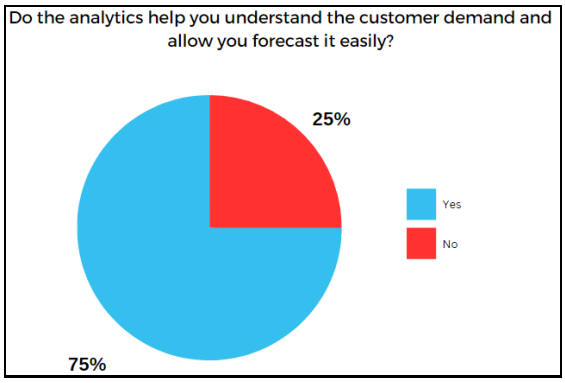

Figure 26. Percentage Of Owners Who Agreed The analytic Help In Forecasting Customer Demand

From the feedback given by the owners, it can be confirmed that the system usability meets the requirement, which is providing automated food ordering system, data analytics for understanding the business and helpful in understanding customer demands with the ability to forecast them. The availability and ability to provide valuable analytic data for owners is a critical standout feature of the proposed system. Shop owners gain access to a wealth of insights and metrics that can help them better understand their business. This includes detailed information on customer preferences, order history, peak hours, popular dishes, and sales trends. Most owners can identify patterns and trends that inform strategic decision-making by analysing those data.

As a downside, it is unfortunate that the integration of the POS system is not developed as there is time and budget limitation for the proposed system. However, there are alternative solutions that can mitigate the impact of this constraint. One possible approach is establishing a seamless data transfer mechanism between the QR code ordering system and the existing POS system. This can involve periodic data synchronisation or the development of APIs to

facilitate data exchange between the two systems. While this may require additional development effort and resources, it can still enable the aggregation of relevant transactional data from the POS system into the analytics component of the QR code ordering system.

VI. CONCLUSION

The proposed system represents a pivotal leap towards transforming restaurant operations, placing a significant emphasis on harnessing the power of data analytics to drive unprecedented efficiency and informed decision-making. By seamlessly integrating QR code ordering and process automation, this innovative solution stands to revolutionize the restaurant industry's landscape. The inherent challenges of traditional ordering systems, like human errors and the cumbersome task of updating menus, are elegantly addressed through this advanced approach.

At the heart of the proposed system lies its remarkable ability to harness data analytics as a driving force [16]. Beyond the surface-level benefits, data analytics emerges as a central component that elevates restaurant management to a new echelon of insights and strategic precision. Through rigorous usability testing with restaurant proprietors, it becomes unmistakably evident that the proposed system delivers on its promise to amplify not only operational efficacy but also the intellectual prowess behind key decisions.

Unleashing the potential of data analytics, this system empowers restaurant owners to traverse beyond the ordinary. Sales data becomes a treasure trove of understanding, aiding in identifying dynamic trends in culinary preferences, forecasting future demands, and devising strategies for optimal resource allocation. This transformative capacity propels the proposed system leagues ahead of conventional approaches. As a triumphant amalgamation of QR code efficiency, process automation, and data-driven intelligence, this solution strives to redefine the very essence of modern restaurant management, cementing its role as a pivotal catalyst for the sector's evolution.

For the future work, the development of POS system integration should be prioritised to enhance the capabilities of the QR code food ordering system with data analytics. Integrating the POS system would provide real-time transactional data, enabling more comprehensive and accurate insights into sales, inventory, and financial performance. Additionally, the integration would facilitate a more seamless and efficient customer experience by enabling synchronisation of orders, payments, and customer data across both systems. Although the development of POS system integration may require additional time and resources, it is a valuable step towards maximising the potential of the QR code food ordering system with data analytics and unlocking deeper insights for business optimisation and growth.

ACKNOWLEDGEMENT

The research work was supported by Faculty of Information Science and Technology, Multimedia University through the Final Year Project and the authors received no funding from any party for the research and publication of this article.

REFERENCES

[1] K. Khairunnisa, A. Johari, M. Wahab, M. Erdi, M. Ayob, A. Ayob, "The Application of Wireless Food Ordering System," MASAUM Journal of Computing, vol. 1, no. 2, pp. 178-184, 2009.

[2] D. Sharma, "A Review of QR code Structure for Encryption and Decryption Process," International Journal of Innovative Science and Research Technology, vol. 2, no. 2, pp. 13-18, 2017.

[3] J. Qianyu, "Exploring the Concept of QR Code and the Benefits of Using QR Code for Companies," Bachelor's Thesis, School of Business and Culture, Lapland University of Applied Sciences, Rovaniemi, Finland, 2014 https://www.theseus.fi/bitstream/handle/10024/85796/JI%20QIANYU-FINAL%20THESIS.pdf?sequence=1.

[4] M. Sadiku, T. J. Ashaolu, A. Ajayi-Majebi, S. Musa, "Big Data in Food Industry," International Journal of Scientific Advances, vol. 3, no. 3, pp. 148 – 152, 2020. doi: 10.51542/ijscia.v1i3.5.

[5] H. Smaya, "The Influence of Big Data Analytics in the Industry," Open Access Library Journal, vol. 9, no. 2, pp. 1-12, 2022. doi: 10.4236/oalib.1108383.

[6] P. L. Bokonda, K. Ouazzani-Touhami N. Souissi, "Predictive analysis using machine learning: Review of trends and methods", International Symposium on Advanced Electrical and Communication Technologies (ISAECT), Marrakech, Morocco, 2020, pp. 1-6. doi: 10.1109/ISAECT50560.2020.9523703.

[7] Yhofoodie, Yhofoodie – About Us, 2018. http://yhofoodie.com/content/details_4_13.html.

[8] S. Kelly, Sakae Sushi First iPad Ordering System in Malaysia, 2019. https://www.sunshinekelly.com/2011/10/sakae-sushi-first-ipad-ordering-system.html.

[9] MA Venture Marketing, My QR Menu – About Us, 2021. https://qrmenu.my/.

[10] Google Charts, Google Chart Tools – QR Codes, 2022. https://developers.google.com/chart/infographics/docs/qr_codes.

[11] Yellowfin, FusionCharts Suite XT – jQuery Charts, 2023. https://www.fusioncharts.com/jquery-charts?framework=jquery.

[12] R. Boggarapu, Dynamic Data Visualization with PHP and MySQL: Election Spending, 2023. https://www.kdnuggets.com/2016/03/dynamic-data-visualization-php-mysql.html.

[13] OpenStax, "Linear Regression", Introductory Business Statistics (Version 2.0), OpenStax CNX, 2022. https://openstax.org/books/introductory-business-statistics/pages/13-4-the-regression-equation?query=linear%20regression&target=%7B%22index%22%3A0%2C%22type%22%3A%22search%22%7D#eip-851.

[14] A. Kondas, PHP-ML: Machine Learning library for PHP, 2022. https://php-ml.readthedocs.io/en/latest/.

[15] N. Abdul Latiff, “The Effect of Workplace Spirituality on Employee Performance”, Issues and Perspectives in Business and Social Sciences (IPBSS), vol. 1, no. 1, pp. 22–27, 2021. doi: 10.33093/ipbss.2021.1.3.

[16] R. Kannan, “Leveraging Business Data Analytics and Machine Learning Techniques for Competitive Advantage: Case Study Evidence from Small Businesses”, International Journal of Management, Finance and Accounting (IJOMFA), vol. 2, no. 1, pp. 73–87, 2021. doi: 10.33093/ijomfa.2021.2.1.3.